IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No	:	09/664,118 Confirmation No. 9049
Applicant	:	Todd L. Lydic et al.
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TC/A.U.	:	3726
Examiner	:	Le, Mark T.
Docket No.	:	JAC-990015
Customer No.	:	36,787

BRIEF ON APPEAL

Sir:

This is in support of the Notice of Appeal filed February 7, 2006, appealing the final rejection of claims 1-20. The Commissioner is hereby authorized to charge deposit account 502800 for any and all fees necessary for filing this brief. The following headings correspond to the requirements of 37 CFR §41.37(c).

(I) REAL PARTY IN INTEREST

The real party in interest is in this application is Freight Car America Corporation, formerly known as Johnstown America Corporation.

(II) RELATED APPEALS AND INTERFERENCES

There are related appeals or interferences known to appellants, the appellants' legal representative, or assignee which may directly affect or be directly affected by or have a bearing on the Board of Appeals ("Board")'s decision in the pending appeal. Specifically Appeal Number 2002-0694 in application number 08/712,369 may have affect this case. A copy of this decision is attached in the appendix.

The Board reversed the examiners stated rejections noting that the relevant applied prior art failed "to disclose cold forming or cold hardening" and did not "expressly teach or inherently require cold forming or hardening in fabricating the disclosed rolled steel center sill." The board then remanded the application back to the examiner for consideration as to whether "it would have been obvious to one of ordinary skill in the art, at the time the appellants' invention was made, to select cold rolling from among the hot rolling and cold rolling method alternatives (Chapter 19 documentation) when fabricating the rolled steel center sill of [the prior art]"

Chapter 25 of the secondary reference has been made of record in the current application and believed to answer the issue raised by the Board on remand and affirmatively establish that it would NOT have been obvious to one of ordinary skill in the art, at the time the appellants' invention was made, to select cold rolling when fabricating the rolled steel center sill of the prior art.

(III) STATUS OF CLAIMS

Claims 1-20 are all the claims pending in the application.

Claims 1-20 are rejected under 35 U.S.C. 103(a) as being obvious in view of the combined teachings of U.S. Patent No. 5,367,958 assigned to Johnstown America Corporation (hereinafter referred to as the "JAC Patent")

taken in view of the teachings of Chapter 19 of The Making Shaping and Treating of Steel.

(IV) STATUS OF AMENDMENTS

A Final Rejection in the above application was mailed November 8, 2005. No after final amendments were filed. All of the substantive rejections of the claims are set forth in the final rejection of November 8, 2005. No claim amendments were filed after final rejection.

(V) SUMMARY OF CLAIMED SUBJECT MATTER

The present invention, in general, to railroad cars and, more specifically, to a rail car having a cold formed center sill and its method of manufacture. (See page 1 lines 9-11). The center sill is the primary structural member of the underframe of a railcar (See page 1 lines 13-14). It is well known to form a center sill by welding a plurality of hot rolled flat pieces or hot rolled sections together as a unit along its substantial length. The use of numerous welds in hot rolled flat pieces to manufacture center sills presents several long-existing problems. The reliance on this process to fabricate a finished center sill is inefficient from both a cost and productivity standpoint. The application of the welds along the lengths of the pieces being joined as a center sill is labor-intensive and cannot attain high-speed production. In addition, the application of multiple welds heats the material being joined and results in heat distortion and warping. Warping creates deviations in the straightness or acceptable tolerances of the center sill being formed. As a result, further physical steps are needed to finish the multiple weld formed hot rolled center sill unit and conform it to acceptable tolerances in camber, sweep and twist to be suitable for use in a railroad car. (See page 1 lines 21- Page 2 line 3).

This invention provides an improved rail car having an improved center sill capable of being cold formed into a straight member having close tolerances. One unique cold formed center sill of the invention has a thickness up to 5/8 inch formed without the use of welds as in the prior art. Because the bent sections forming the shape of the center sill are cold worked numerous times during working, the material is strengthened to resist crippling and

produce a stronger cross section without thicker sections or reinforcing material. The center sills are open at the bottom to provide desired access within the center sill body. Some of the configurations of the center sill according to the present invention may include extra structural features that provide enhanced strength characteristics without adding a significant weight. (See Page 2 line 15 to Page 3 line 5).

Referring to FIG. 1, there is illustrated a railroad gondola car 2 having an underbody carried by opposed truck assemblies 4. The underbody of the railroad car of the invention includes a continuous single piece or two piece center sill 6 extending substantially the entire length of the car. A railcar body 7 is attached to the underframe. The single or double piece center sills of the invention provide significant advantages over prior center sills and contribute to a lightweight, economical car design. (See page 3 line 31 to page 4 line 9).

Referring now to FIGS. 2, 3, 4 and 6 there is illustrated the single and two piece center sill of the invention, generally designated by reference numerals 6a, 6b, 6c and 6d. The center sills 6a-6d are formed in a generally rectangular configuration from a single flat one-piece plate or coiled sheet of steel (6a-6c) or two welded pieces (6d). The center sill is formed by bent sections created in the cold forming process from a material having a thickness of up to 5/8 inch with thicknesses of either 3/8 inch to 5/8 inch being preferable. The center sills 6a-6d includes an upper flat top wall 10, 54 and 80 and a pair of flat side sections or webs 12, 32, 52 and 82, each of generally constant thicknesses. The top wall 10, 54 and 80 and pair of side sections 12, 32, 52 and 82 are joined together at right angles by upper curved sections 14, 36, 55, and 84. The bottom sections 16, 34, 58, and 86 of the center sill 6a are inwardly formed horizontally at right angles to the side sections 12, 32, 52 and 82 through curved connecting sections 18, 38, 59 and 88. The bottom sections 16 may terminate with a free end 20 to form a longitudinal opening 22 through which access within the center sill 6a is provided. The bottom sections 34 may terminate with an upturned internal flange 40 to form the longitudinal opening

through which access within the center sill 6b is provided. The side section 52 may have ribs 50 for additional support.

(VI) <u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

Claims 1-20 are rejected under 35 U.S.C. 103(a) as being obvious in view of the combined teachings of the JAC Patent taken in view of the teachings of The Making Shaping and Treating of Steel.

(VII) <u>ARGUMENTS</u>

1. Claims 1-20 are rejected under 35 U.S.C. 103(a) as being obvious in view of the combined teachings of the JAC Patent taken in view of the teachings of The Making, Shaping and Treating of Steel.

<u>a. Claims 1, 3, 7, 9 and 10</u>

The prior art of record establishes that, prior to the applicant's disclosure, there was no known method of <u>cold forming rail car center sills.</u> The JAC Patent itself notes that the center sill 16 is a box beam shape that is fabricated from steel or other suitable material (see column 2 lines 7-11). The examiner asserts that since it is silent as to how the center sill is made it would be obvious to make it in any known metal working fashion. This is not accurate or appropriate. One of ordinary skill in the art reading the JAC Patent would fabricate the center sill in fabrication methods that are known in the art for creating railcar center sills. As established in the background of the invention of the present application, the other prior art of records, AND MOST NOTABLY in the secondary reference, the Making, Shaping and Treating of Steel, the known methods of fabricating railcar center sills is fabrication of two (or more) hot rolled sections.

The secondary reference The Making, Shaping and Treating of Steel is an exceptionally well known, well references and authoritative work in the iron and steel industries. The work is currently in its 11th edition and is now published by the Association for Iron and Steel Technology. The first through ninth editions were published by US Steel Corporation, with the tenth edition apparently being a joint publication between the two publishers in a transition.

This authoritative work must be considered for what it would teach one of ordinary skill in the art when considered in its entirety.

The secondary reference when considered as a whole EXPRESSLY TEACHES AWAY FROM THE SUGGESTED MODIFICATION. Chapter 25 of the reference expressly teaches the method of forming railcar center sill sections. Chapter 25 describes the "special structural sections include shapes rolled rarely or for a single purpose. The passes used for the production of zee bars involve the same principles as the rolling of angles by the butterfly method, with each half of the pass resembling an angle pass, and with the two halves being fitted together reversed. <u>The half center-sill section, used in making modern railroad cars, is a special type of zee bar, being irregular in both thickness of the members and flange lengths. Passes for its production are included here (Figure 25-9) because of the relatively great demand for the section</u>." (Emphasis added). The secondary reference even illustrates the hot rolled passes that are typical for a railroad car center sill in figure 25-9.

The examiner's suggested modification must disregard the explicit teaching of the secondary reference. One of ordinary skill in the art in viewing the two cited references would <u>make the railcar center sills in the exact manner described in the references.</u> Namely a fabrication of steel as stated in the JAC Patent which is a connection of <u>two hot rolled zee bar</u> sections as stated in the Making Shaping and Treating of Steel. The examiner cannot ignore the express teachings of the combined references.

The evidence in this application establishes exactly what is stated in the background of the invention. The prior art cited by the examiner EXPRESSLY TEACHES the hot rolling of the railcar center sills. The examiner's suggested combination of the prior art references and the suggested result is simply untenable.

<u>b. Claims 2 and 18</u>

Claim 2 depends from claim 1 and further defines "wherein said center sill includes two cold formed sections and no more than one weld seam connecting said two cold formed sections."

The applicants have asserted that the JAC Patent discloses a center sill which would be well known to those of ordinary skill in the art and would be formed as a fabrication of hot rolled sections welded together. The applicants believe the secondary reference further supports such assertions. The examiner has countered with the argument that one of ordinary skill in the art would glean from the JAC Patent a "<u>single element that is not formed by welding</u>". Assuming one were to accept the examiner's statements, then it does not teach or suggest TWO PIECE COLD FORMED CENTER SILL with no more than one weld seam as defined in claim 2.

The prior art, even when viewed as the examiner has stated, does not teach or suggest a railroad car center sill that includes two cold formed sections and no more than one weld seam connecting them.

Claim 8 depends from claim 7 and is similar to claim 2 discussed above.

<u>c. Claims 4, 5, 11 and 12</u>

Claims 4 and 5 depend from claim 3 and further define a cold formed center sill for a railcar which has a substantially uniform thickness of between about 3/8 inch to about 5/8 inch, or which weighs less than 80 pounds per foot. As discussed in the specification the single piece center sill of the invention is lightweight, being approximately 1,000 pounds or more lighter than conventional welded sills (see page 9 of the specification). Further, the center sill of the present invention "does not require thicker sections or added material as in the prior art and provides a lightweight, high-strength member".

The appellants are imminently familiar with the center sill disclosed in the JAC Patent as this is the center sill type that they were improving upon. There is nothing in the JAC Patent to teach or suggest a cold formed center sill section which has a substantially uniform thickness of between about 3/8 inch to about 5/8 inch, or which weighs less than 80 pounds per foot. The examiner can obviously point to nothing that suggests these limitations and has simply ignored them with an unsupported conclusion that such dimensions "would be matters of design choice."

The examiner has not even come close to meeting his burden of establishing a prima facia case of obviousness with regard to these limitations. The examiner's statements amount to a simple dismissal of the claim limitations, and such is inappropriate. Further, as the examiner is attempting to rest much of his rejections on the explicit figures of the JAC Patent, it is noteworthy that the illustrated corner portions of the center sill 16 are NOT uniform with the remaining sections.

Claims 11 and 12 depend, indirectly, from claim 7 and are similar to claims 4 and 5 discussed above.

d. Claims 6, 8 and 15

Claim 6 depends from claim 1 and defines that "said center sill is formed of a single cold formed section without weld seams." The examiner maintains that because the JAC Patent does not expressly illustrate the weld seams in the center sill of the JAC Patent then it "would not be proper to" suggest that they are present. The examiner correctly states that the issue is what the drawings (and indeed the entire patent) would reasonably disclose and suggest to one of ordinary skill in the art.

The JAC Patent notes that the center sill 16 is a steel fabrication. No further discussion is needed as this conventional component is not the focus of the JAC Patent. Clearly one of ordinary skill in the art would review this disclosure and fabricate the center sill 16 from steel as is conventional in the art, which is described in chapter 25 of the secondary reference, namely a fabrication of several hot rolled sections.

The single cold formed section is simply not taught or suggested in the applied prior art.

Claim 8 depends from claim 7 and is similar to claim 6.

e. Claims 13-17

Claim 13 depends from claim 7 and further defines that "said center sill has at least four work hardened corners." The center sill of the JAC Patent,

has, as most center sills do, at least four corners. However, even if one were to form the center sill of the JAC Patent from no more than two cold formed sections with no more than one weld seam as required in claim 7, such a method does not necessarily result in four cold worked corners as such, in theory, could be the connection point between separate sections. Consequently this limitations is believed to further define from the reasonable disclosure of the applied prior art.

f. Claims 19-20

Claim 19 depends from claim 18 discussed above and is similar to claim 13 discussed above.

CONCLUSION

The examiners rejections ignore the explicit TEACHINGS OF THE REFERENCES and selected claim limitations present in the above identified claims. Based on the above, Appellants respectfully request that the Board reverse the Examiner on the rejection of the claims.

Respectfully submitted,
Blynn Shideler

/Blynn L. Shideler/
Registration No. 35,034

CLAIM APPENDIX

Following is a complete listing of the claims involved in the appeal.

1. A railcar comprising:

a plurality of truck assemblies, each truck assembly having at least one wheel

an underbody supported on said truck assemblies, said underbody including a cold formed center sill extending substantially the length of said railcar; and

a railcar body attached to said underbody.

2. The railcar according to claim 1 wherein said center sill includes two cold formed sections and no more than one weld seam connecting said two cold formed sections.

3. The railcar according to claim 1 wherein said center sill includes a generally hollow rectangular configuration with an open bottom.

4. The railcar according to claim 3 wherein said center sill has a substantially uniform thickness of between about 3/8 inch to about 5/8 inch.

5. The railcar according to claim 3 wherein said center sill weighs less than 80 pounds per foot.

6. The railcar according to claim 1 wherein said center sill is formed of a single cold formed section without weld seams.

7. A gondola railcar comprising:

a pair of spaced truck assemblies, each truck assembly having four wheels; and

an underbody supported on said truck assemblies, said underframe including a cold formed center sill, said

center sill comprising no more than two cold formed sections, and no more than one weld seam connecting said cold formed sections.

8. The gondola railcar of claim 7 wherein said center sill is formed of a single cold formed section without weld seams.

9. The gondola railcar of claim 8 wherein said center sill includes a generally hollow rectangular configuration with an open bottom.

10. The gondola railcar of claim 9 further including at least one tub extending below said center sill between said pair of truck assemblies.

11. The gondola railcar of claim 10 wherein said center sill has a substantially uniform thickness of between about 3/8 inch to about 5/8 inch.

12. The gondola railcar of claim 11 wherein said center sill weighs less than 80 pounds per foot.

13. The gondola railcar of claim 7 wherein said center sill has at least four work hardened corners.

14. The gondola railcar of claim 13 wherein said center sill includes a pair of bottom wall portions, each said bottom wall portion extending inwardly from one side edge thereof.

15. The gondola railcar of claim 14 wherein said center sill is formed of a single cold formed section without weld seams.

16. The gondola railcar of claim 15 further including at least one tub extending below said center sill between said pair of truck assemblies.

17. The gondola railcar of claim 16 wherein said center sill includes a generally hollow rectangular configuration with an open bottom.

18. The gondola railcar of claim 7 wherein said center sill includes two cold formed sections and no more than one weld seam connecting said two cold formed sections.

19. The gondola railcar of claim 18 wherein said center sill has at least four work hardened corners.

20. The gondola railcar of claim 19 further including at least one tub extending below said center sill between said pair of truck assemblies.

EVIDENCE APPENDIX

The following is an electronic copy of chapter 25 of the Making, Shaping and Treating of Steel reference, chapter 19 of which the examiner utilizes in the outstanding rejection. Both Chapters 19 and 25 are made of record in the current application in the Notice of References Cited form PTO-892 forwarded with the office action of July 7, 2005.

Chapter 25

Structural and Other Shapes

Section 1

Equipment for Producing Shapes

In rolling-mill parlance, the word "shape" is used interchangeably with the word section" in describing forms of rolled material (except for geometrical shapes, which are known as rounds, squares, hexagons, etc.). Shapes, or sections, are normally divided into two classes, structural and other sections. Structural sections include standard items, such as I-beams, channels, angles, and wide flange beams, and special sections such as zees, tees, bulb angles, and car-building center sills. Other sections include such miscellaneous shapes as steel H-piles, sheet piling, tie plates, cross ties, and those for special purposes.

The production of shapes, as enumerated above, involves a number of processes which are generally common to all of them. These processes include heating of the bloom, rolling to proper contour and dimensions, cutting while hot to lengths that can he handled, cooling to atmospheric temperature, straightening, cutting to ordered lengths, inspecting, and shipping.

The heating of the bloom for large sections is done in either of two types of furnaces, the in-and-out, or the continuous, which are described in Chapter 21. The in-and-out furnace is the more common of the two and serves nearly all of the older structural mills. A typical mill uses three furnaces of this type, having hearth areas about 18 feet by 36 feet. The newer mills tend to use continuous furnaces because of the greater economy, one or two continuous

furnaces being sufficient. Practical widths of this type furnace can accommodate blooms up to 30 feet long, and one furnace of proper length, designed according to the cross-section of blooms to be heated, can have sufficient capacity to supply a mill. To hold heat loss to a minimum, furnaces are usually located adjacent to a bloom-storage yard. or the delivery table from a blooming mill, or both, and at a minimum distance from the first stand of the mill on which shapes are to be rolled.

A typical mill for the production of structural sections is shown schematically in Figure 25-1. It has a two-high reversing breakdown stand in which the initial shaping is accomplished, followed by a group of three stands, arranged in train, where the rolling process is completed. The first of these three stands, known as the rougher, is three-high. The middle stand, which is known as the intermediate, is also three high, and continues the formation of the shapes to almost finished dimensions. The finishing stand, which is usually two-high, establishes the final shape of the rolled section. Under some conditions it is desirable to have a three-high stand for the finisher. The two-high breakdown stand is fitted with rolls of cast steel, either carbon or alloy, with pitch diameter typically 36 inches, and body length 80 inches. The roughing, intermediate, and finishing stands, which are sometimes referred to collectively as the finishing mill, usually employ rolls with a pitch diameter between 28 inches and 33 inches, and a body length of 68 inches. Cast rolls are used on these three stands, usually of carbon or alloy steel, grain or sand iron (see Chapter 20), the selection being based on service requirements.

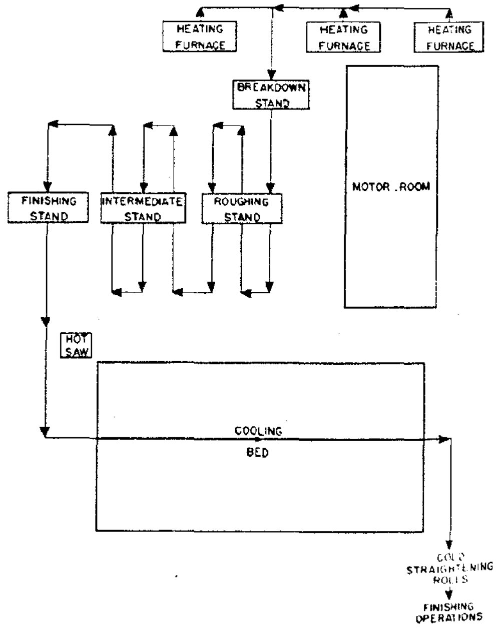

Fig. 25-1. Diagrammatic layout (not to scale) of a typical mill for rolling structural sections.

In modern mills all of these rolls are driven by electric motors, with direct-current variable-speed reversing motors being essential for the breakdown stands, and preferred for all stands. On breakdown mills, the motor drives through a flexible connection to a two-high set of pinions, and through spindles to the rolls. Most structural finishing mills drive the three stands from a single motor, through a single three-high set of pinions, the drive being carried by spindles from the pinions to the roughing rolls, and by other spindles from the roughing rolls to the intermediate rolls. Two more spindles, connected to the middle and bottom rolls of the intermediate stand, drive the finishing rolls. Horsepower requirements vary, with 5000 horsepower being typical for breakdown stands, and 6000 horsepower typical for the finishing mill.

The breakdown stand is normally served by stationary roller tables equipped with mechanical manipulators. The shape is conveyed into, and received out of, the finishing mill passes by traveling, tilting, roller tables.

The mill equipment for the production of wide- flange beams and H-piles is substantially different from that used in the production of other shapes. The distribution of metal in the web and flanges of wide- flange beams is such that beams of this type have maximum resistance to bending moment with mini

mum weight per foot length of beam, and the thick ness of metal in the web is usually less than that in the flanges. On the other hand, the bearing piles, known as steel H-piles, while essentially wide-flange beams, are produced with an equal thickness of metal in the web and flanges to provide: (1) ruggedness to resist driving forces; and (2) the same thickness of metal in all parts to provide uniform life under corrosive conditions, for the entire cross-section. Two or three groups of roll stands may be used, with each group containing more than one set of rolls. Figure 25-2 shows the schematic arrangement for a typical mill. This mill has a roughing group of stands which consist of a two-high roughing edging stand, closely associated with a roughing main stand, which has two horizontal main rolls and two friction-driven

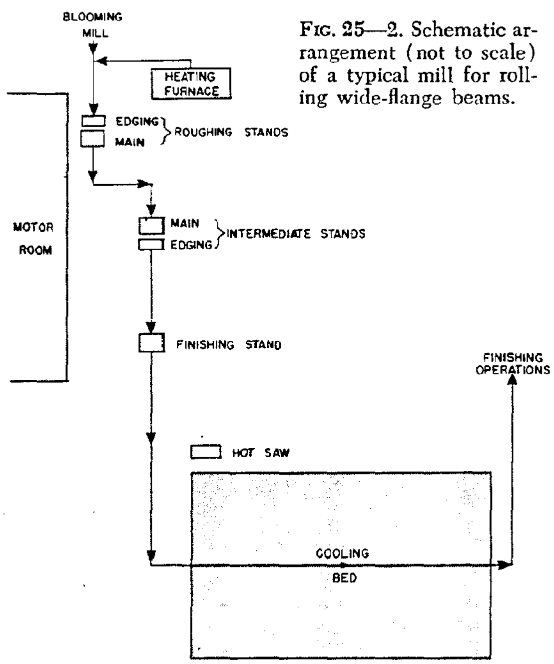

FIG. 25—2. Schematic arrangement (not to scale) of a typical mill for rolling wide-flange beams.

vertical rolls in a single vertical plane. The rolls in the roughing edging stand have a nominal diameter of 30 inches at the working zone and a body length of from 20 inches to 48 inches varying according to the depth of section rolled. The roughing main rolls have a nominal body diameter of 52 inches with a body length matching the edging rolls. Vertical rolls in the roughing stand, having a nominal diameter of 42 inches and a face width of 18 inches, are friction driven by the shape about a roller bearing in their bore. The intermediate group of stands is identical in all of

the above particulars to the roughing group, with the exception of the edging stand being on the opposite end of the main stand. The finishing stand resembles the roughing and intermediate main stands in that it has main and vertical rolls of the same size in like arrangement, but does not have edging rolls. The general arrangement of the mill is such that the hot shape from the blooming mill or reheating furnace enters first into the roughing edging stand and before clearing that stand enters the roughing main stand. The intermediate group of stands is placed a minimum distance to the side and one maximum shape length beyond the roughing group. The main intermediate stand is on the side toward the rougher and is closely followed by the intermediate edging stand, again arranged so that a single shape is in both stands of the group simultaneously (12½ foot centers). The finishing stand is in line with the intermediate group and 186 feet beyond the intermediate edging stand. Stationary roller tables are provided throughout with a short transfer mechanism to move the shape from the line of the roughing group of stands to the line of the intermediate group. All of these stands are driven by direct-current reversing motors, each individual stand having a separate motor, two-high pinions, and the necessary spindles. The roughing and intermediate main stands are driven by 7000-horsepower motors, and their respective edgers by 2000-horsepower motors. The finishing-stand motor is rated at 4000 horsepower.

Rolled shapes are further processed with equipment which is substantially the same for shapes produced on the standard type of structural mill as on the wide- flange-beam mill.

Removing ends not filled to proper section, commonly called “crop ends,” and cutting the hot shape into lengths which can be handled in further processing, is done with a hot saw. This equipment consists of a toothed circular saw blade mounted on a sliding frame and driven at high speed by an electric motor. Blades range up to 66 inches in diameter and copious water cooling helps maintain the cutting edges. The saw and its drive are moved on a

sliding base at right angles to the hot shape so that the revolving blade cuts through the stationary shape.

Cooling of the rolled shapes is accomplished by placing them on a cooling bed which is a steel structure, arranged to support a continuous layer of shapes, while providing for a maximum circulation of air up ward around them. A mechanism is provided to pull the shapes sideways into place and to slide them across the bed onto the discharge table.

Large shapes are straightened by roller-type straightening equipment, or a gag press. The former normally consists of seven or eight cast-iron or cast steel rolls assembled in a single housing with a single drive, driving either part or all of the rolls. The top rolls are placed midway between the bottom rolls and may be moved vertically by screws. All rolls are arranged for axial adjustment. The gag press consists of a horizon tally-reciprocating ram midway between two support points on a platen which is so arranged that it can be moved closer to or further away from the ram, thereby varying the amount of bend made in the shape.

Cold cutting to final length is accomplished by shearing or cold sawing. The shears consist of a stationary bottom blade over which the shape is positioned, and a top blade which is forced down on the top of the shape to cut it through, either with a single shearing action, or by punching a slug, or short piece, out of the shape. The cold saw is similar in design and action to the hot saw, but is fed at a substantially slower rate.

Section 2

ROLLING METHODS AND PROCEDURES

The practice of heating blooms for rolling into shapes varies with the quality of the steel, the size of the bloom, and the temperature at which the blooms are charged. A typical mill charges ordinary carbon- steel blooms received from the blooming mill at about 18000 F and heats them to 22500 F in approximately 45 minutes. On a mill using three in-and-out type furnaces, normal operations find one furnace being charged, one heating, and the other

being drawn, at a given time, Charging of the single layer of blooms in a furnace is begun as soon as the drawing has been completed. When steel at atmospheric temperature is charged, the heating to 22500 F requires about 2½ hours for the average size bloom. Handling the blooms into and out of the furnaces is accomplished by charging machines which grip the blooms on their sides. This necessitates a space between adjacent blooms of some six or eight inches as clearance for the charging-machine tongs.

Rolling-Heated blooms are deposited by the charging machine on the breakdown-stand approach table, which conveys them to the rolls. The manipulators, on the entry side of the mill, are brought into play to align the bloom with the first pass and to turn it about its longitudinal axis, if necessary. When properly aligned, the table rollers are revolved to feed the bloom into the first pass of the rolls. The rolls for the breakdown-stand generally have three or more pass grooves, some of which may be rectangular blooming passes. The number of different shaped grooves in the rolls, and the number of passes made in each groove, vary with the section being rolled. After making the required number of passes through the first groove, the bloom is re-aligned for subsequent passes by the manipulators.

Blooms processed through the breakdown-stand progress over the stationary rollers of the delivery table to the traveling tilting table which carries the bloom into line with the first pass of the roughing stand. Since the finishing-mill rolls are not reversed during operation, only a single pass is made through each groove. Similar tables on the opposite side of the finishing mill receive the shape from the first groove and enter it into succeeding grooves. Roughing- and intermediate- stand rolls usually contain from two to five pass grooves, while finishing-stand rolls are generally limited to a single pass on a shape. Finishers usually have duplicate grooves for the same section, or provide grooves for a variety of sections.

The type of section resulting from the rolling process is determined by the shape of the various pass grooves through which the material progresses,

with optional groups of pass shapes frequently being avail able for the production of a given section. In the case of standard beams, at least three different systems of passes may be used.

The most common pass shapes used in rolling standard beams are those of the straight-flanged method which are shown in Figure 25-3. This method owes its popularity to the large range of web thicknesses which can be produced from a single set of rolls, the ability to use the early passes for the production of channels as well as beams, and the small thrust loads transmitted by the rolls to the bearings. The versatility of the weights produced results from the relatively small total taper in the live or open flanges which permit rolls to be separated to produce heavier webs with a minimum thickening of the live flange. The most undesirable feature of this method is the relatively slight taper in the pass sides which reduces the gain on dressing and results in passes getting progressively wider and flanges relatively heavier when dressed, thereby limiting the life of the rolls.

The butterfly method of rolling beams closely resembles the straight-flanged method. The outstanding difference is the fact that the live flanges are bent out to a much greater degree in all passes preceding the finishing pass. This results in greater ease of restoring the open flanges by dressing, but imposes a serious limitation on the range of web thicknesses that can be produced in a given set of passes.

Figure 25-4 illustrates the passes used in the diagonal method of rolling beams. This method makes good provision for the restoring of both flange thick ness and pass width b dressing. but involves serious restrictions in the web thicknesses that can be satisfactorily produced from a single set of rolls, and vastly increases the thrust loads that are imposed on the bearings which support the rolls. Since thrust—bearing wear permits

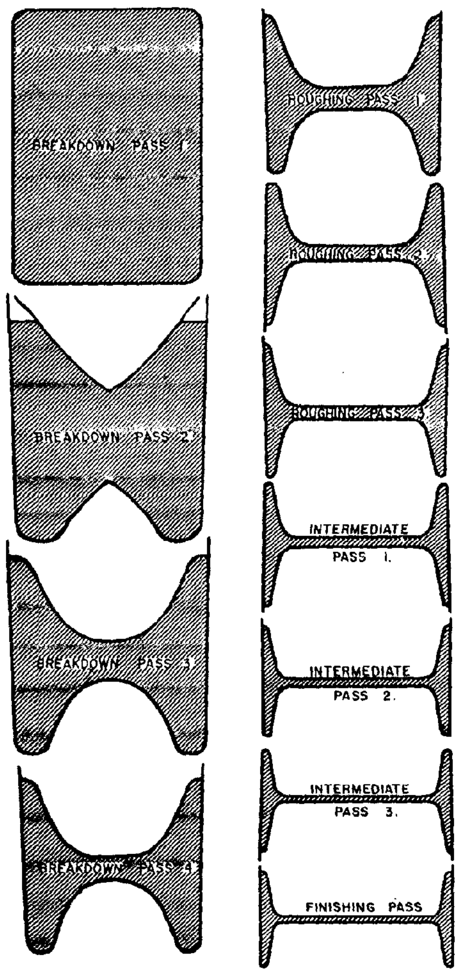

Fig. 25—3. Roll passes for rolling standard beams by straight-flanged method.

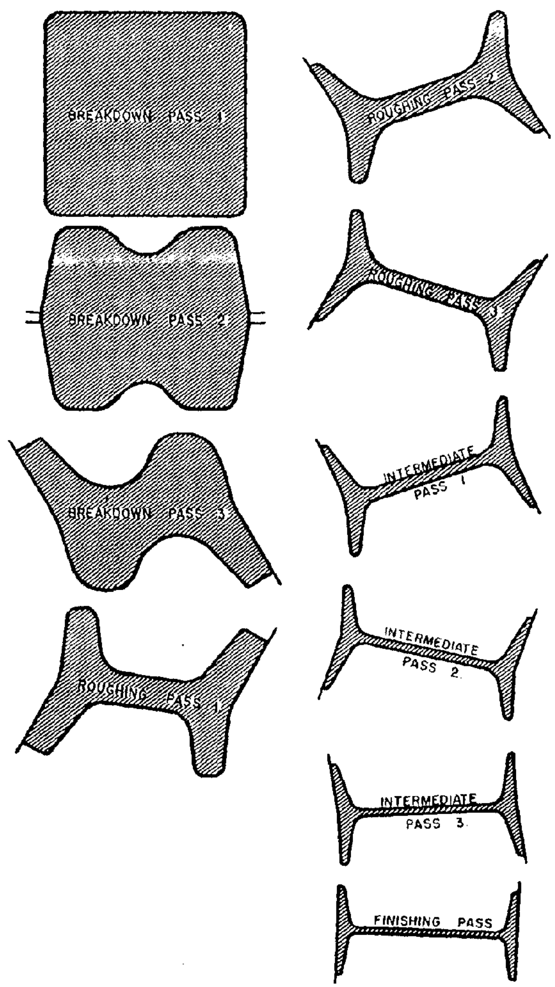

Fig. 25—4. Roll passes for rolling beams by the diagonal method.

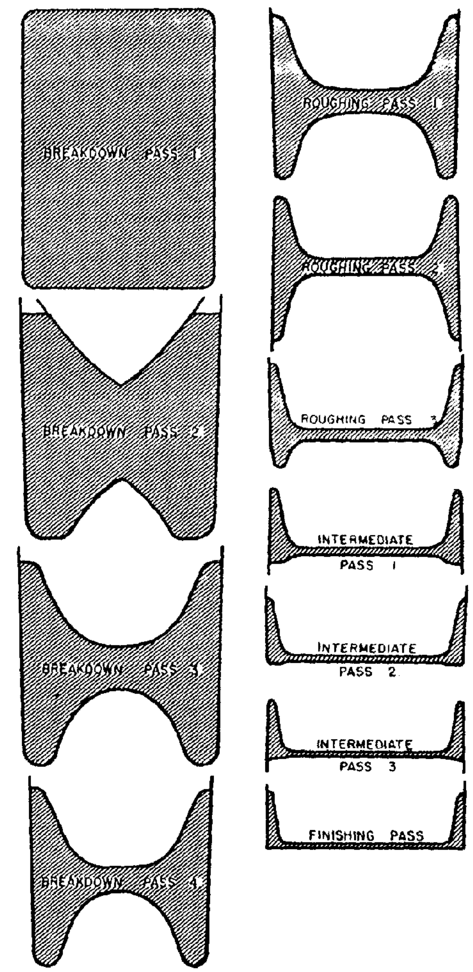

Fig. 25—5. Roll passes for producing a channel, using early passes shared for rolling beams.

longitudinal motion of the rolls with corresponding changes to the thickness of the open flanges, rolling difficulties result.

The method of rolling a channel using early passes shared with a standard beam is illustrated in Figure 25-5. This plan results in a smaller roll inventory, good flange control in the production of a large range of weights, narrower passes and stronger collars than can be had if the butterfly method is used. Figure 25-6 shows the butterfly design. It has the advantage of producing channels which are filled to proper see- lion very close to the ends of the rolled bars. How ever, this method of production results in relatively thin weak collars on the rolls and almost precludes the rolling of multiple weights. This is caused by the extreme thickening of the flanges in the early passes when the rolls are separated to produce a thicker web.

Angles also offer the roll designer a choice between a number of proven rolling methods. Those most generally approved today may be referred to as the butterfly and the flat-and-edge methods. Typical passes for the butterfly angle are shown in Figure 25-7. The current popularity of this method is due to the relatively small crop loss on the shapes, the absence of vertical rolls or turning for edging, and the ease of controlling the bending, which is slight in any one pass. Undesirable features of the design are the lack of proportional thickening of the various parts of each leg when rolls are separated to make heavy weights, and somewhat poorer control of leg length,

The fiat-and-edge type of design can be seen in Figure 25-8. This method is popular on those mills having vertical edging rolls and is sometimes used where the shape is turned 900 for edging in a pass in horizontal rolls. Leg lengths are readily controlled in the edging passes and thicknesses remain uniform when rolls are set to produce heavy weights. These advantages are frequently offset by the difficulty in maintaining propel' entry alignment of the section in the later passes where bending is drastic. Turning long lengths of hot, flexible steel for edging, where that is necessary, is also difficult.

The special structural sections include shapes rolled rarely or for a single purpose. The passes used for the production of zee bars involve the same principles as the rolling of angles by the butterfly method, with each half of the pass resembling an angle pass, and with the two halves being fitted together reversed. The half center-sill section, used in making modern railroad cars, is a special type of zee bar, being irregular in both thickness of the members and flange lengths. Passes for its production are included here (Figure 25-9) because of the relatively great demand for the section.

Modern practice tends towards the production of tees by splitting a beam of proper size through its web to make two of tile required sections. Some tees, how ever, are still rolled as such. The rolls are unduly complicated and the actual rolling is difficult. Where a choice is offered, the rolling of tees is usually avoided because of tile necessity of turning the section between passes to permit each of the two tapered flanges and the parallel stem to he worked alternately so far as possible, in open and closed grooves.

One of the most interesting groups of sections produced upon standard structural mills is the sheet-piling group. (Steel sheet piling of domestic manufacture is produced almost exclusively to ASTM specification A-328.) Usually produced in three general types, known as straight web, arch web, and zee, these sections have been adapted as wall members in both permanent and temporary structures requiring strong vertical walls for lateral support, such as coffer dams, piers, dykes, breakwaters, etc. In the rolling of piling sections, the usual problems are complicated by the necessity of bending the flange (which has been rolled straight) to form the interlock. Precise control of the bend is necessary since proper clearance within the interlock must be maintained and the resulting opening between flange tip and thumb must be within close limits. The particular arch web section for which passes are shown in Figure 25—10 accomplishes this bending of the flange in two steps in the leader and finishing passes. Attention should be given to the fact that the shaping of the section starts in the blooming mill. This is typical of most piling sections and large beams, and is the result of the large size of the sections

coupled with their intricate shape which precludes getting enough passes into the limited space of the breakdown and finishing mills to properly form the section.

While the rolling procedure for a section on the standard type of structural mill does not normally employ the same pass groove for more than one reduction in the shape, multiple passes being limited to the breakdown stand and seldom exceeding three passes in a groove, the opposite situation exists on the wide flange beam mill. Here as many as fifteen successive passes are taken through the main and edging stands of the roughing group. In a typical layout, the main and vertical rolls of the roughing main stand and the rolls of the roughing edging stand are moved to new settings with respect to each other by an automatic screwdown control. With this mechanism, the operator sets in advance of rolling the reduction to be taken on each pass. Then, pass by pass, he advances the lever of the master control switch a notch, with each of the three sets of rolls of the roughing group moving closer together simultaneously to the new set tings. The control equipment is so designed that each of the three sets of rolls can be made to move different amounts, thus permitting proportional rather than like reductions on flange and web.

The equipment of the intermediate group of stands is practically the same as the roughing equipment. As in the rougher, fifteen passes are provided for in the control equipment. In practice, the passes are divided between the roughing and the intermediate stands in a proportion that gives equal duration of rolling cycle in each of tile two stands. Since the shape at the roughing stand is relatively heavy and short, more passes are required there to balance the relatively few passes made on the elongated shape at the intermediate stands. Passes in actual use range from fifteen roughing and nine intermediate on sections requiring heavy overall work, to five roughing and three intermediate on the sections requiring a minimum of work; nine roughing and five intermediate passes represent the average condition. In all cases the intermediate passes arc followed by a single finishing pass. In rolling wide-

flange beams it is customary to roll a bloom which has, as nearly as possible, the same proportions as the finished beam. Each succeeding pass in the rolling cycle strives to maintain these proportions, resulting in reduction, pass b pass, being proportional. Since at no time after leaving the blooming mill are the flanges rolled in a closed groove, the loss in flange length is very small, and the rolling of beams with extremely high flanges is entirely possible.

Rolled material from either of the described structural mills is delivered by roller table to the hot saw. The blade of the saw is normally revolved in such a direction that the cutting edge is moving downward toward the shape. The action of the rapidly revolving toothed blade combines a mechanical sawing and melting of the steel, the chips

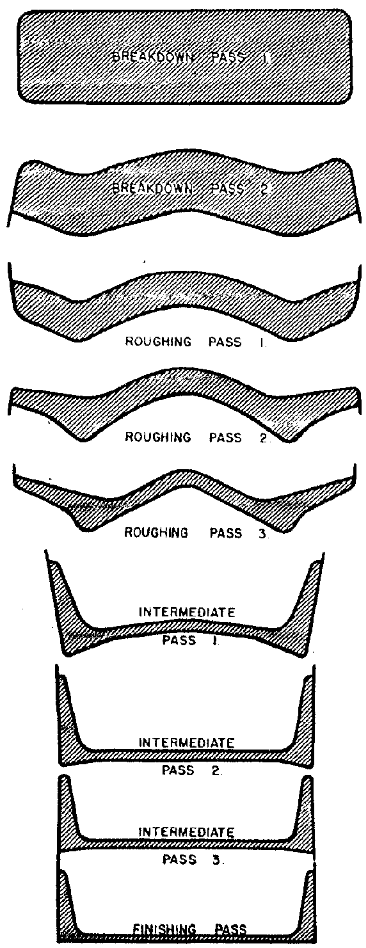

Fig. 25—6. Roll passes for rolling a channel by the butterfly method.

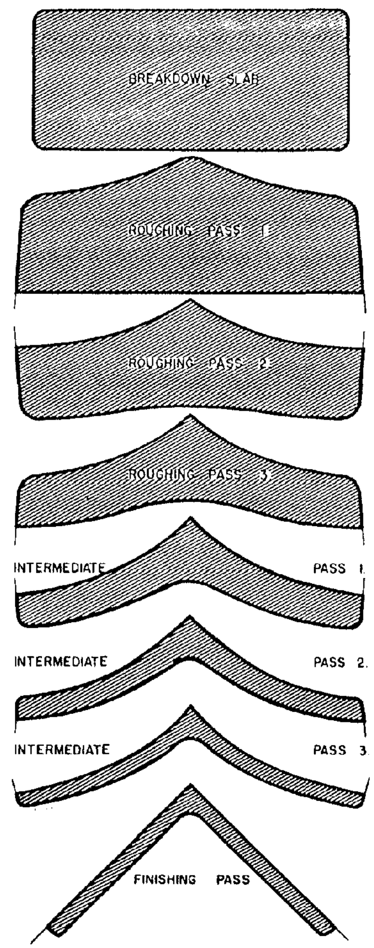

Fig. 25—7. Roll passes for rolling an angle by the butterfly method.

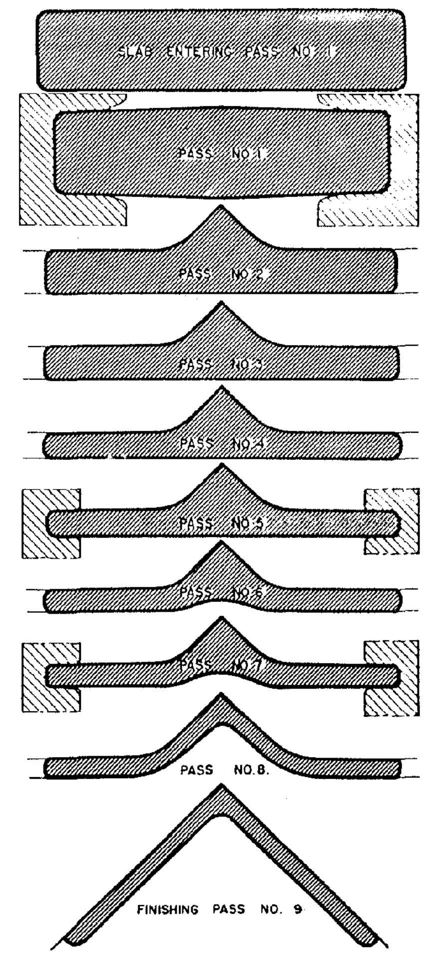

Fig. 25—8. Roll passes for producing an angle by the flat-and-edging method.

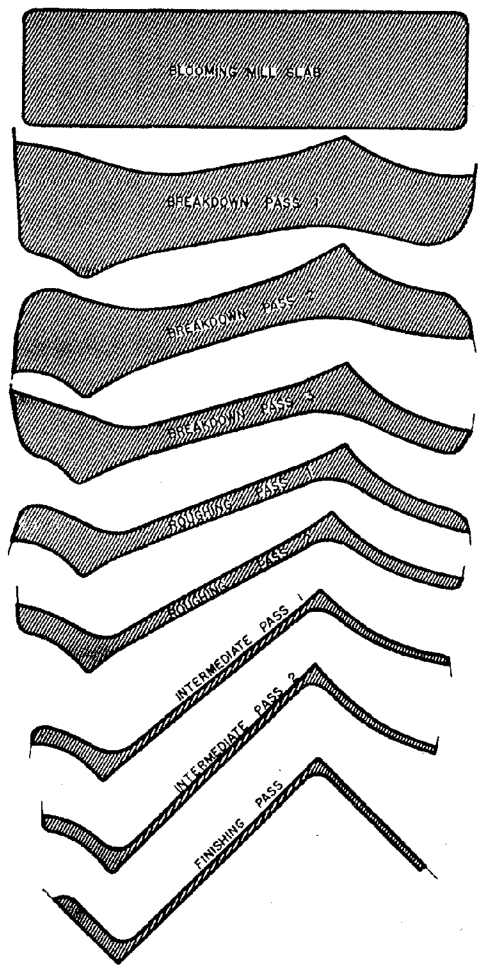

Fig. 25—9. Roll passes for the production of a half center-sill section, a special type of zee bar.

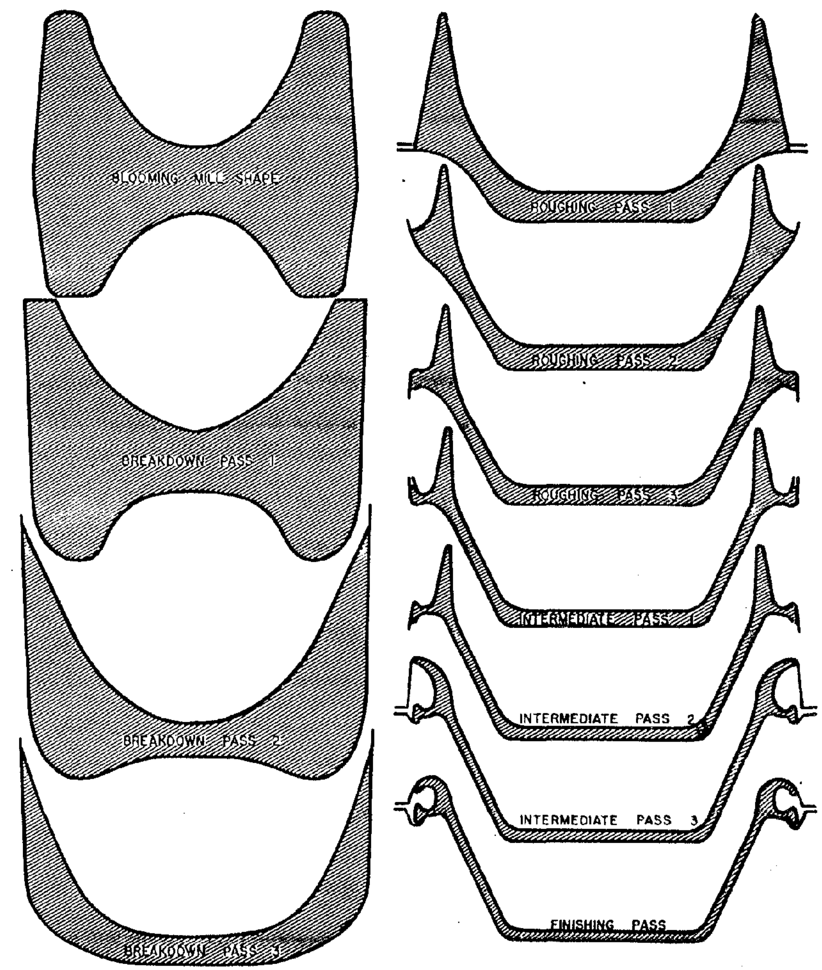

Fig. 25—10. Roll passes for rolling an arch web section of sheet piling, showing how flange is bent to accurate configuration in the leader and finishing passes.

when thrown clear frequently being molten. Cuts are usually made at the hot saw to remove the crop ends, to part the usable material into lengths that can be handled for further processing, and to provide short test pieces. Tests are cut for the guidance of the roller in correcting defects in the section and for various mechanical tests which are part of the inspection procedure.

Cooling is accomplished by the natural circulation of air about the shapes on the cooling bed. The rate of cooling can, to some extent, be controlled, and is of relative importance. Cooling can be accelerated by maintaining space between shapes on the bed, and by providing ample space below the bed for the passage of cool air. Retarding of the cooling cycle results from putting the hot shapes on the bed in a solid touching layer. If cooling is too drastically retarded, the size of the hot bed must be increased or rolling delays will result. On the other hand, too rapid cooling may result in mechanical properties outside the ordered range. Non-uniform cooling results in warpage of the shapes as they cool. This must be avoided in symmetrical shapes, if possible. Most non-uniform shapes warp during cooling, sometimes to the point that they are difficult to convey to the straightening machine.

Section 3

FINIGHING AND INSPECTION

When the shapes have been properly cooled they are conveyed again by roller table to the straightening machine. For the products rolled on the standard type of structural mill and the smaller wide-flange beams, a roller straightener is normally used. The first shape to be straightened is stopped in the machine while the rolls are adjusted laterally to it. The top rolls are then moved downward to deform the shape with each successive top roll making less deformation than the pre ceding one. This shape is backed out of the machine and then run through for most of its length. If not straight to the eye of the experienced operator it is again reversed in the machine. Further adjustment is made with this process being repeated until a straight shape is obtained. Subsequent shapes will require only slight alteration to the setting of the

machine to compensate for wear and other variables. The larger wide-flange beams and some few standard mill products are straightened in the gag press. Here the process consists of advancing the stationary platen and the shape towards the reciprocating ram until a bend is accomplished in the shape. The operator has full control of the point on the shape at which the bend will be made, the amount of the bend, and by turning on the table, the direction of the bend. Bending strives only to offset initial crookedness.

Cutting to final length is accomplished by one of several means. Hot shearing or hot sawing are most commonly used, wherever the class of product permits. Cold sawing is the next most frequently used method. Flame cutting is available for extremely heavy sections and unusual applications. Where over all length must be accurate, as in the case of columns, the ends may be milled: this results not only in close length tolerance, but in a reduction in the ends' out- of-square allowance as well.

Before the products rolled on the various mills may be shipped, they must be inspected for defects and tested for certain mechanical properties. This is accomplished by two general methods. First, the test cuts taken at the hot saw are sent to the laboratory where tests are made to determine the mechanical properties of the material, such as tensile strength and yield point. The other method of inspection is visual inspection of the material on an inspection bed where the shapes are inspected for metallurgical defects, such as pipe, blister and scabby surface, and for dimensional variations such as length, straightness, and out-of-square condition. Dimensions such as web or flange thickness, flange height, weight per foot, etc., are checked on tests taken at the hot saw by the mill inspector, and the roller then adjusts the mill to correct improper conditions. Special sections may require additional inspection. An example is the slot and thumb on sheet piling. Chemical composition of all material is known, as a record is kept of all rolled products showing the number of the heat from which it was rolled.

The final steps are to separate and assemble for shipment. The material then is loaded in freight cars, river barge, or truck, and shipped to its destination.

RELATED PROCEEDINGS APPENDIX

A copy of the decision on appeal, appeal number 2002-0694 which reversed all of the examiners stated reasons for rejection is attached hereto as this appendix. The document was obtained from the Patent Office Pair site.

The Board reversed the examiners stated rejections noting that the relevent applied prior art failed “to disclose cold forming or cold hardening” and did not “expressly teach or inherently require cold forming or hardening in fabricating the disclosed rolled steel center sill.” The board then remanded the application back to the examiner for consideration as to whether “it would have been obvious to one of ordinary skill in the art, at the time the appellants’ invention was made, to select cold rolling from among the hot rolling and cold rolling method alternatives (Chapter 19 documentation) when fabricating the rolled steel center sill of [the prior art]”

Chapter 25 of the same work has been made of record in the current application and believed to answer the issue raised by the Board on remand and affirmatively establish that it would NOT have been obvious to one of ordinary skill in the art, at the time the appellants’ invention was made, to select cold rolling when fabricating the rolled steel center sill of the prior art. This chapter of the secondary reference establishes the hot rolling process for forming railroad center sills.